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## CLAIMS

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[Claim(s)]

[Claim 1]A luminescent material in which oxygen tension is a luminescent material which makes a main component a perovskite type compound of an  $ABO_3$  presentation produced under an atmosphere lower than the atmosphere, and a part of A, B, or both parts are characterized by replacing only a predetermined addition by other element A' and B'. However, A and A' is a group IIIb element containing Ia fellows, IIa fellows, or rare earth, and B and B' is a transition metal or a group IIIa element from VIb to IIb.

[Claim 2]A luminescent material, wherein said A is a group IIIb element in the luminescent material according to claim 1 and said B is a group IIIa element.

[Claim 3]A luminescent material characterized by said A' being IIa fellows in the luminescent material according to claim 2.

[Claim 4]A luminescent material characterized by said B being aluminum in the luminescent material according to claim 3.

[Claim 5]A luminescent material characterized by said A being yttrium or lanterns, and those mixtures in the luminescent material according to claim 3.

[Claim 6]A luminescent material, wherein it is the luminescent material according to claim 1, 2, 3, 4, or 5 and said predetermined addition is 10% or less.

[Claim 7]Light equipment using the luminescent material according to claim 1, 2, 3, 4, 5, or 6.

[Claim 8]Light equipment which is light equipment using the luminescent material according to claim 7, and possesses a discharge device, a current injection device, or an ultraviolet radiation excitation source as a driving source.

[Claim 9]Light equipment which is light equipment using the luminescent material according to claim 1, and used the amplification effect by optical gain which material has.

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[Translation done.]

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the light equipment which used a luminescent material and it.

[0002]

[Description of the Prior Art]Since the foreign rare earth element etc. were used for all the oxides that have the perovskite structure used as a luminescent material until now as a luminescence center, the luminous wavelength and selectivity of material had restriction. Although  $\text{YAlO}_3$  which doped Nd as an example is known as a laser material, the luminous wavelength is limited to the narrow wavelength area decided with Nd ion. Since electron transition was prohibition, oscillator strength was small, and it was difficult to realize a device compact as a laser material.

[0003]On the other hand, although various kinds of fluorescent substances and laser crystals are known as crystalline luminescent materials other than perovskite, all have the same fault.

[0004]As a trial which makes the mother crystal itself emit light, the luminescent material using  $\text{LaAlO}_3$  produced under reducing atmosphere is got by artificers. Although this material had a large emission spectrum and was provided with the feature useful as a luminescent material, there were problems, like crystal growth with sufficiently stable luminescence intensity is difficult, and there is. [Y.Kawabe, A.Yamanaka, E.Hanamura, T.Kimura, Y.Takiguchi, H.Kan, and and Y.Tokura"Photoluminescence of perovskite. lanthanum aluminate single crystals"J.Appl.Phys.87-7594 (2000)] .

[0005]

[Problem(s) to be Solved by the Invention]As described above, since the operational mode of peak wavelength, power, CW, or a pulse, efficiency, etc. are decided with the optical activity material which the solid light sources represented by the solid-state laser use, a broad optical activity material is called for. An oxide is excellent in a resistance to environment, and much optical activity material, such as  $\text{Nd:YAlO}_3$ , is found out. Although development is tried as a luminescent material as a superconducting material as for the perovskite type oxide of attention, the element (Ti) which serves as a luminescence center like  $\text{Ti:LaAlO}_3$  is added, and Kawabe and others reports luminescence from a parent. Although there is [above-mentioned technical literature], luminescence intensity is weak and it cannot fully use as an optical activity material.

[0006]An object of this invention is to provide the light equipment using the luminescent material and it which have stronger stable luminescence intensity at a room temperature in the infrared range from near-ultraviolet

in view of the above-mentioned situation.

[0007]

[Means for Solving the Problem] This invention is to achieve the above objects, [1] A luminescent material in which oxygen tension is a luminescent material which makes a main component a perovskite type compound of an  $ABO_3$  presentation produced under an atmosphere lower than the atmosphere, and a part of A, B, or both parts are characterized by replacing only a predetermined addition by other element A' and B'. However, A and A' is a group IIIb element containing Ia fellows, IIa fellows, or rare earth, and B and B' is a transition metal or a group IIIa element from VIb to IIb.

[0008][2] Above [1] In a luminescent material of a statement, it is characterized by said A's being a group IIIb element and said B being a group IIIa element.

[0009][3] Above [2] In a luminescent material of a statement, it is characterized by said A' being IIa fellows.

[0010][4] Above [3] In a luminescent material of a statement, it is characterized by said B being aluminum.

[0011][5] Above [3] In a luminescent material of a statement, it is characterized by said A being yttrium or lanthans, and those mixtures.

[0012][6] Above [1]\*\*[2]\*\*[3]\*\*[4] or [5] It is a luminescent material of a statement and is characterized by said predetermined addition being 10% or less.

[0013][7] Above [1]\*\*[2]\*\*[3]\*\*[4]\*\*[5] or [6] Light equipment using a luminescent material of a statement.

[0014][8] Above [7] It is light equipment using a luminescent material of a statement, and a discharge device, a current injection device, or an ultraviolet radiation excitation source is provided as a driving source.

[0015][9] Above [1] Light equipment which is light equipment using a luminescent material of a statement, and used the amplification effect by optical gain which material has.

[0016]

[Embodiment of the Invention] Hereafter, an embodiment of the invention is described in detail.

[0017] First, the manufacturing method of the luminescent material of this invention is explained.

[0018] although La of a group IIIb, Y, etc. are the typical thing as an element of A position of the  $ABO_3$  compound of this invention, it is not what is limited to this -- in addition, rare earth and IIa fellows -- it may be the mixture composition further. Although the compound of B position has group IIIa elements, such as aluminum, or a preferred transition metal of IVb-IIb, similarly it is not limited to it. The selection same also about A' and B' as A and B is possible.

[0019] (1) The 1st example (crystal growth  $Ca:YAlO_3$ )

$Y_2O_3$  5.162g,  $aluminum_2O_3$  11.320g, and  $CaO$  0.057g were mixed, a balloon 6 mm in diameter was stuffed, the hydrostatic pressure of 300Mpa was impressed in product SPT made from NICHIDEN Machinery 119-10T, and the stock bar was produced. The stock bar was calcinated at 1000 \*\* among the atmosphere for 4 hours, and it was made to grow up in product SC-M made from NICHIDEN Machinery 50XS in argon and hydrogen mixed gas atmosphere of 4% of hydrogen concentration. Xenon electric bulb current was set as 58A, and the growth rate was set up in 20.05 mm /in an hour. As a result, a single crystal body 3.7 mm in diameter and 25 mm in length was obtained.

[0020] (2) The 2nd example (crystal growth  $Ca:LaAlO_3$ )

$La_2O_3$  8.065g,  $aluminum_2O_3$  2.549g, and  $CaO$  0.029g were mixed, a balloon 6 mm in diameter was stuffed,

the hydrostatic pressure of 300Mpa was impressed in product SPTmade from NICHIDEN Machinery119-10T, and the stock bar was produced. The stock bar was calcinated at 1000 \*\* among the atmosphere for 256 hours, and it was made to grow up in product SC-Mmade from NICHIDEN Machinery 50XS in argon and hydrogen mixed gas atmosphere of 4% of hydrogen concentration. Xenon electric bulb current was set as 75A, and the growth rate was set up in 20.00 mm /in an hour. As a result, a single crystal body 3.8 mm in diameter and 13 mm in length was obtained.

[0021](3) The 3rd example (crystal growth Ba:LaAlO<sub>3</sub>)

La<sub>2</sub>O<sub>3</sub> 8.537g, aluminum<sub>2</sub>O<sub>3</sub> 2.671g, and BaO0.086g were mixed, a balloon 6 mm in diameter was stuffed, the hydrostatic pressure of 300Mpa was impressed in product SPTmade from NICHIDEN Machinery119-10T, and the stock bar was produced. The stock bar was calcinated at 1000 \*\* among the atmosphere for 215 hours, and it was made to grow up in product SC-Mmade from NICHIDEN Machinery 50XS in argon and hydrogen mixed gas atmosphere of 4% of hydrogen concentration. Xenon electric bulb current was set as 73A, and the growth rate was set up in 20.06 mm /in an hour. As a result, a single crystal body 3.5 mm in diameter and 15 mm in length was obtained.

[0022](4) The 4th example (Sr:LaAlO<sub>3</sub>)

SrO0.036g and La<sub>2</sub>O<sub>3</sub> 5.699g which were produced by heat-treating SrCO<sub>3</sub> at 1250 \*\* for 12 hours, and aluminum<sub>2</sub>O<sub>3</sub> 1.784g are mixed, A balloon 6 mm in diameter was stuffed, the seal of approval of the hydrostatic pressure of 300Mpa was carried out in product SPTmade from NICHIDEN Machinery119-10T, and the stock bar was produced. The stock bar was calcinated at 1000 \*\* among the atmosphere for 16 hours, and it was made to grow up in product SC-Mmade from NICHIDEN Machinery 50XS in argon and hydrogen mixed gas atmosphere of 4% of hydrogen concentration. Xenon electric bulb current was set as 76A, and the growth rate was set up in 20.01 mm /in an hour. As a result, a single crystal body 3.6 mm in diameter and 42 mm in length was obtained.

[0023](5) The 5th example (Ca:GdAlO<sub>3</sub>)

Gd<sub>2</sub>O<sub>3</sub> 8.974g, aluminum<sub>2</sub>O<sub>3</sub> 2.498g, and CaO0.028g were mixed, a balloon 6 mm in diameter was stuffed, the hydrostatic pressure of 300Mpa was impressed in product SPTmade from NICHIDEN Machinery119-10T, and the stock bar was produced. The stock bar was calcinated at 600 \*\* among the atmosphere for 160 hours, and it was made to grow up in product SC-Mmade from NICHIDEN Machinery 50XS in argon and hydrogen mixed gas atmosphere of 4% of hydrogen concentration. Xenon electric bulb current was set as 63A, and the growth rate was set up in 20.05 mm /in an hour. As a result, a single crystal body 3.1 mm in diameter and 37 mm in length was obtained.

[0024]Next, measurement of the above-mentioned luminescent material is explained.

[0025](1) The emission spectrum of Ca:YAIO<sub>3</sub> obtained in the 1st and 2nd examples, and a Ca:LaAlO<sub>3</sub> crystal, When glared by 355-nm laser, respectively strong red luminescence was obtained [ <sub>3</sub> / Ca:YAIO] about green and Ca:LaAlO<sub>3</sub>. The result of having measured the emission spectrum with the experimental device shown in drawing 1 using CCD-IMAX512 Acton a spectroscope and 320i, and by the Princeton instrument company is shown in drawing 2.

[0026]It is a figure showing the result of having measured drawing 1 with the lineblock diagram of the

experimental device (the 1) of the luminescent material of this invention, and having measured drawing 2 with the experimental device.

[0027]in drawing 1 -- 1 -- laser and 2 -- a wavelength changing crystal and 3 -- a dichroic mirror and 4 -- a filter, and 5 and 6 -- a reflective mirror and 7 -- as for luminescence from the sample 8, and 11, a sample and 9 are [ a photodetector and 13 ] personal computers (PC) a spectroscope and 12 a stage and 10 a lens and 8.

[0028]Then, the 1.064-micrometer light emitted from the laser 1 is entered into two or more wavelength changing crystals 2, The generated 355-nm ultraviolet radiation is taken out with the dichroic mirror 3 and the filter 4, by using the mirrors 5 and 6, it adjusts to a predetermined propagating direction and the sample 8 is further irradiated using the lens 7. The position of the sample 8 is finely tuned by the stage 9.

[0029]By irradiating with the above-mentioned ultraviolet radiation, the luminescence 10 generated from the sample 8 is led to the spectroscope 11 with a lens, and is detected by the photodetector 12 with which it was equipped. At this time, luminescence intensity is transmitted to PC13 at the same time it is controlled by PC13 so that the photodetector 12 and the laser 1 synchronize.

[0030]In drawing 2, a horizontal axis is wavelength and the vertical axis shows PL intensity (relative intensity). The upper row is the result of being based on the sample of the 2nd example, and the lower berth expresses the result based on the sample of the 1st example.

[0031](2) The result of having measured the luminescence life of the green emission of  $\text{Ca:YAlO}_3$  obtained in the 1st example using CCD-IMAX512 by the Princeton instrument company was 16 ns. A result is shown in drawing 3.

[0032]Drawing 3 is a figure showing the result depended on the experimental device (the 2) of the luminescent material of this invention, time is shown on a horizontal axis (ns) and luminescence intensity is shown on the vertical axis by it.

[0033](3)  $\text{Ca:YAlO}_3$  was excited by a 355-nm pulse laser beam, and using the experimental device shown in drawing 4, when transmitted light intensity was simultaneously measured using tunable laser, it was checked that the transmitted light is amplified in 480 to 550 nm.

[0034]Drawing 4 is a lineblock diagram of the experimental device (the 2) of the luminescent material of this invention.

[0035]As for tunable laser and 26, in this figure, laser, and 22, 24 and 25 are [ a photodetector and 28 ] oscilloscopes a sample and 27 a mirror and 23 21.

[0036]Then, a direction is adjusted with the mirror of 24 and 25 for the emitted light from the tunable laser 23 at the same time it irradiates the sample 26 with the laser 21 which has the wavelength of 355 nm using the mirror 22, He enters into the sample 26 and is trying to observe the change in a penetration by monitoring the transmitted light using the photodetector 27 and the oscilloscope 28.

[0037]Two comparative examples are explained below.

[0038](1) The 1st comparative example (emission spectrum of  $\text{LaAlO}_3$ )

Green luminescence was obtained when irradiated with the emission spectrum of the crystal which does not contain Ca produced by the same method as the 2nd example by 266-nm laser. Luminescence intensity was 1/20 compared with the 1st example. The result of having measured the emission spectrum using CCD-IMAX512 Acton a spectroscope and 320i, and by the Princeton instrument company is shown in drawing 5.

When it excited at 355 nm, only still weaker luminescence was observed.

[0039]Drawing 5 is a figure showing the measurement result of the 1st comparative example, wavelength (nm) is shown on a horizontal axis and emission spectrum intensity (relative unit) is shown on the vertical axis by it.

[0040](2) The 2nd comparative example (measurement of the profit of  $\text{LaAlO}_3$ )

$\text{LaAlO}_3$  was excited by the pulse laser beam (355 nm and 266 nm), when white light was simultaneously measured for transmitted light intensity using the same experimental device as what was illustrated above (3), amplification of light was not observed but increase of absorption was observed.

[0041]This invention is not limited to the above-mentioned example, and based on the meaning of this invention, various modification is possible for it and it does not eliminate these from the range of this invention.

[0042]

[Effect of the Invention]As mentioned above, as explained in detail, according to this invention, it found out that the crystal which has stronger luminescence intensity could produce stably by replacing some elements of the position of A or B of an  $\text{ABO}_3$  compound by element A' of another kind, and B'. The emission spectrum and intensity, and a luminescence life clarified the controllable thing with the kind and concentration of A' and B'. Having an optical profit was shown by by exciting strongly some compounds produced by these techniques in the source of pulse ultraviolet radiation. The rates of the element replaced here are 2% - 0.0001% more desirably 10% or less.

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[Translation done.]